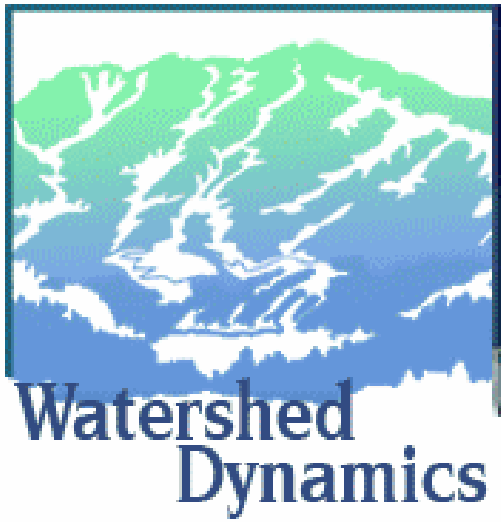
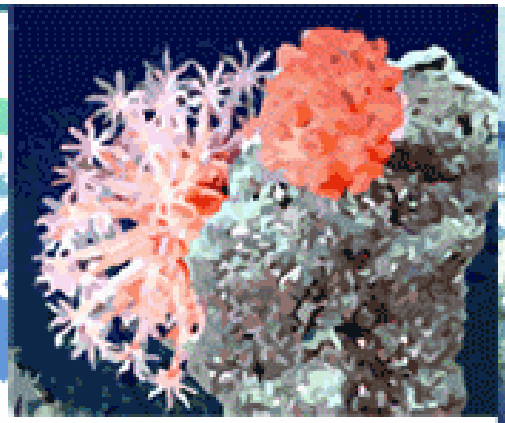
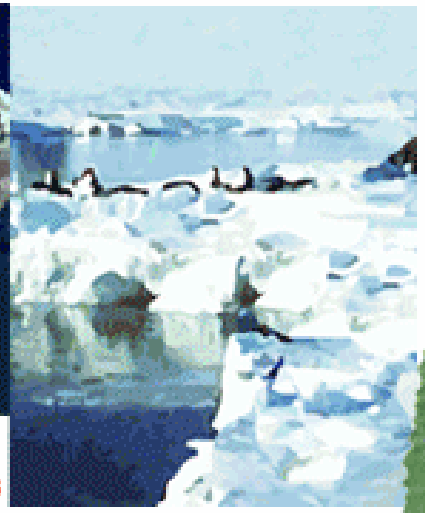
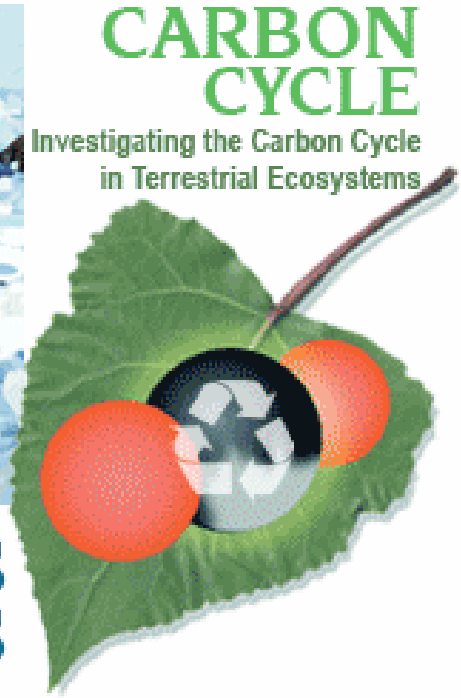
GLOBE's New Earth System Science Projects (ESSPs)









www.globe.gov/essp

NASA NSF UNITED STATES DEPARTMENT OF STATE

Watershed Dynamics

Danny Edelson, Kemi Jona - Northwestern University
David Maidment, University of Texas-Austin

GEODE INITIATIVE

Geographic Data in Education

CUAHSI

universities allied for water research

Watershed Dynamics Project

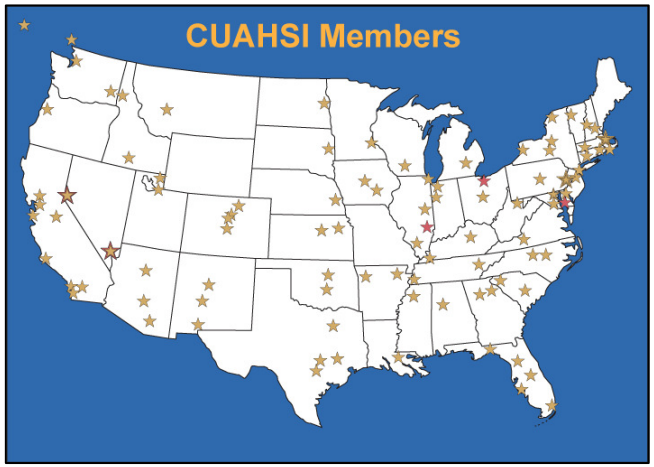
Provide students with the opportunity to conduct investigations using real-time and archival data from the large-scale scientific observatory being constructed by the Consortium of Universities for Advancement of Hydrologic Science (CUAHSI)

Goals

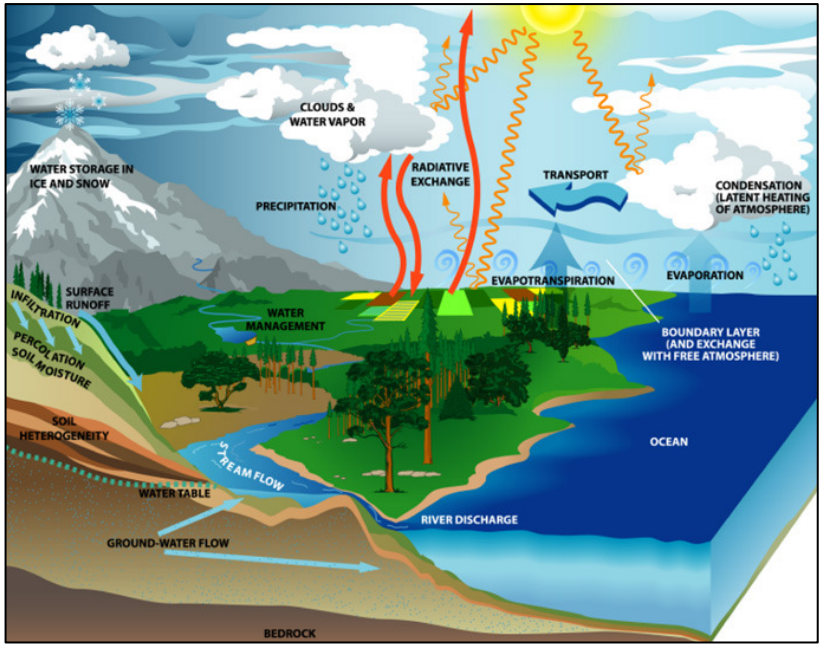
- Design scientific investigations supported by technology that will support student inquiry through data analysis using live links to CUAHSI (& GLOBE) data servers;
- Develop middle and high school learning activities to enable students to master the geosciences content and data analysis practices in the investigations;
- Conduct targeted outreach and professional development activities for upper primary and secondary school teachers and CUAHSI researchers including both live workshops and online courses;
- Engage in software and data library development activities to assemble a suite of technological tools that will provide a student-friendly “front end” for accessing and analyzing CUAHSI and GLOBE data; and
- Conduct an evaluation to assess how well the project has achieved its objectives and to identify issues for future work.

Who is CUAHSI?

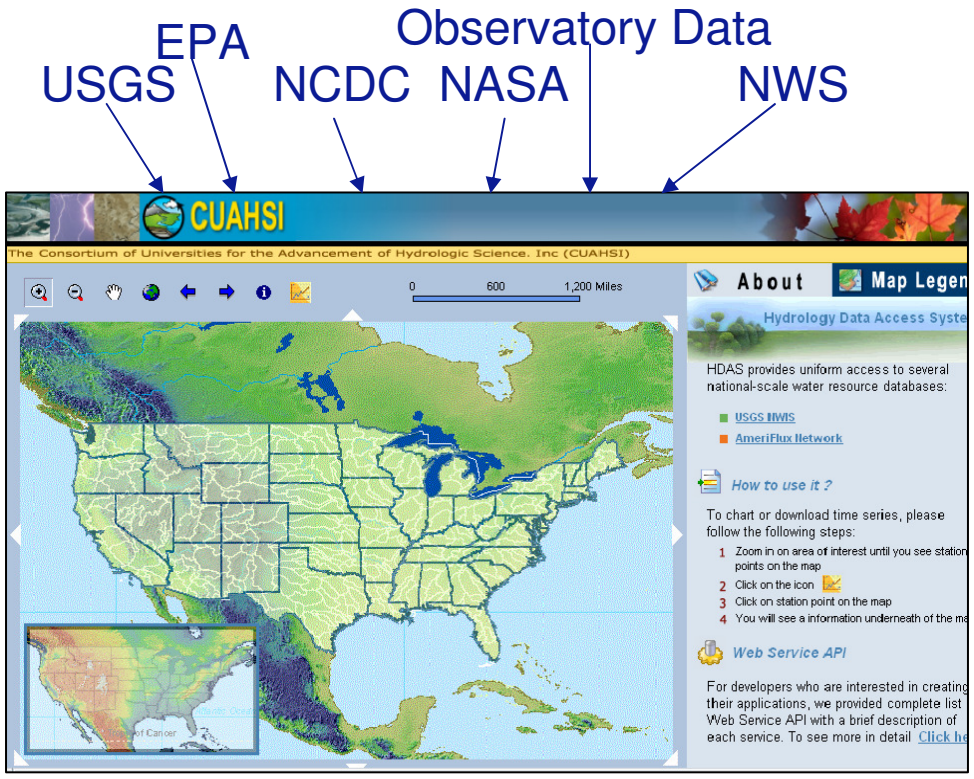
- A consortium of 103 research universities, 4 affiliate members, and 2 international affiliates
- Project Staff:
  - David Maidment (Texas)
  - Rick Hooper (CUAHSI)
  - Tim Whiteaker (Texas)
  - Praveen Kumar (UIUC)



- **Science Objective**: To further predictive understanding of the terrestrial hydrologic cycle and its linkages with climate and biogeochemical cycles
- **Societal Need**: Will there be enough water for the next century?
  - …of appropriate quality
  - …to meet society's needs
  - …to maintain the integrity of our ecosystems

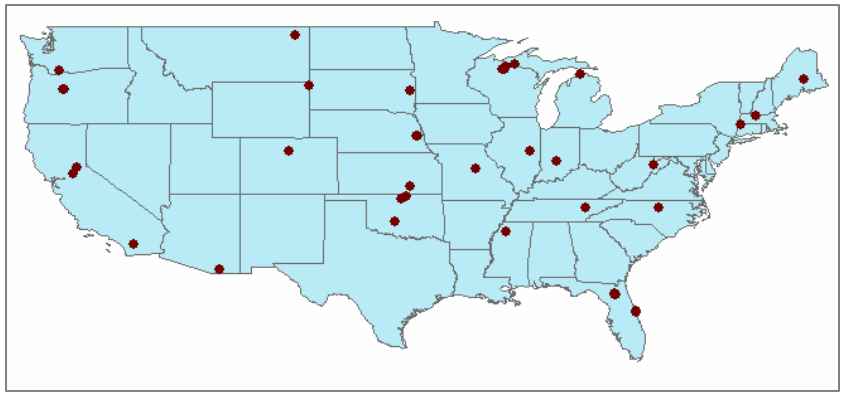


Hydrologic Information System

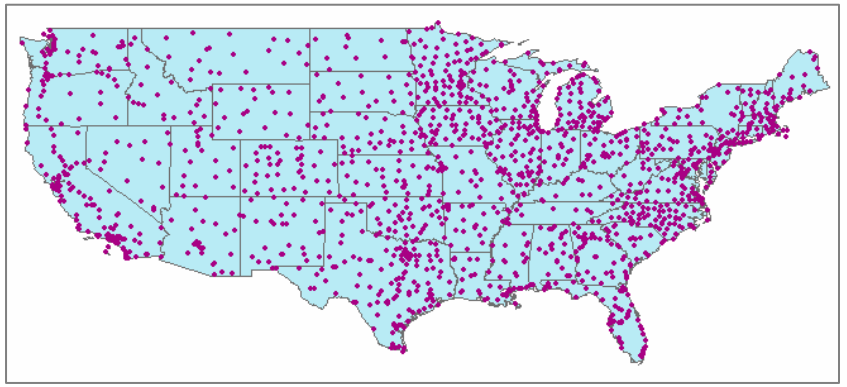


CUAHSI is engaged in developing a **Hydrologic Information System** (HIS) that aggregates hydrologic datasets from numerous sources, including real-time and near real-time data on stream flow, ground-water, and water quality.

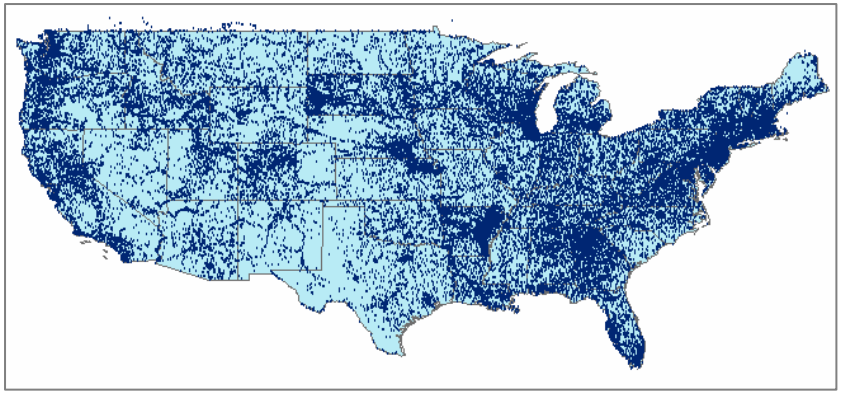
Observation Data



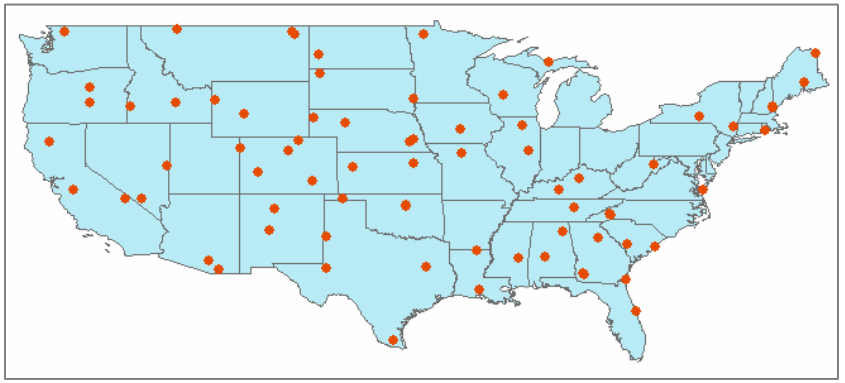
Ameriflux Towers



Automated Surface Observing System

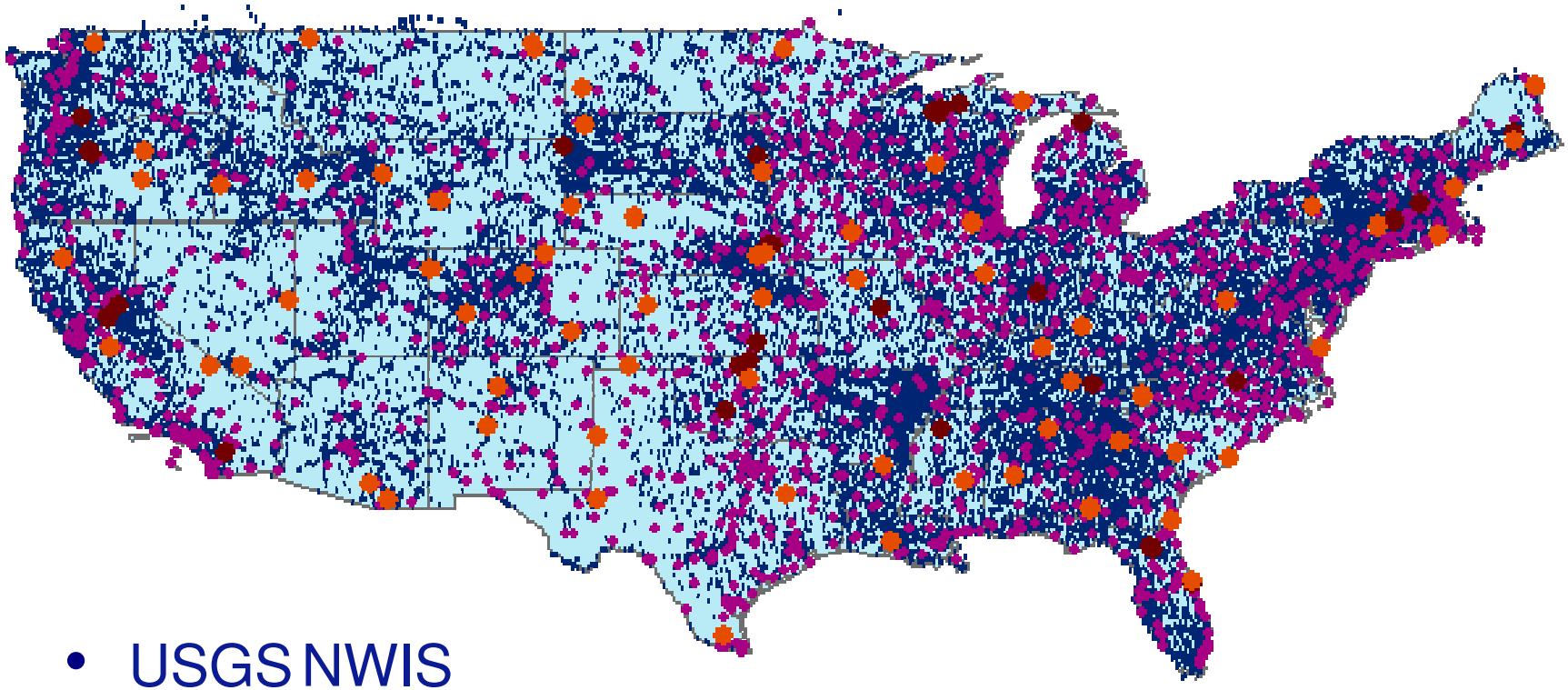


USGS NWIS Stations



Climate Reference Network

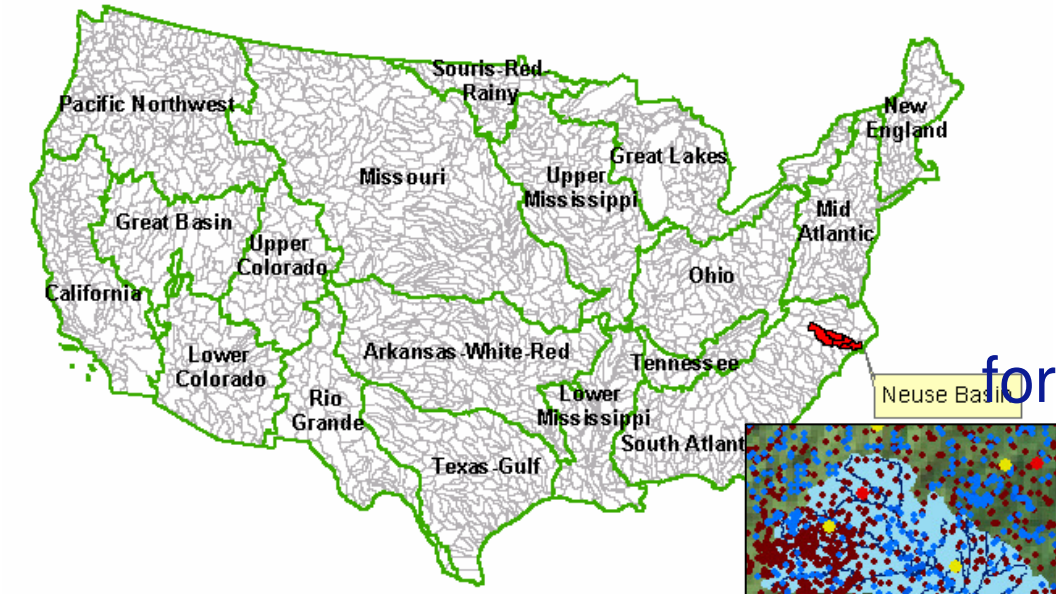
Observation Site Map for US



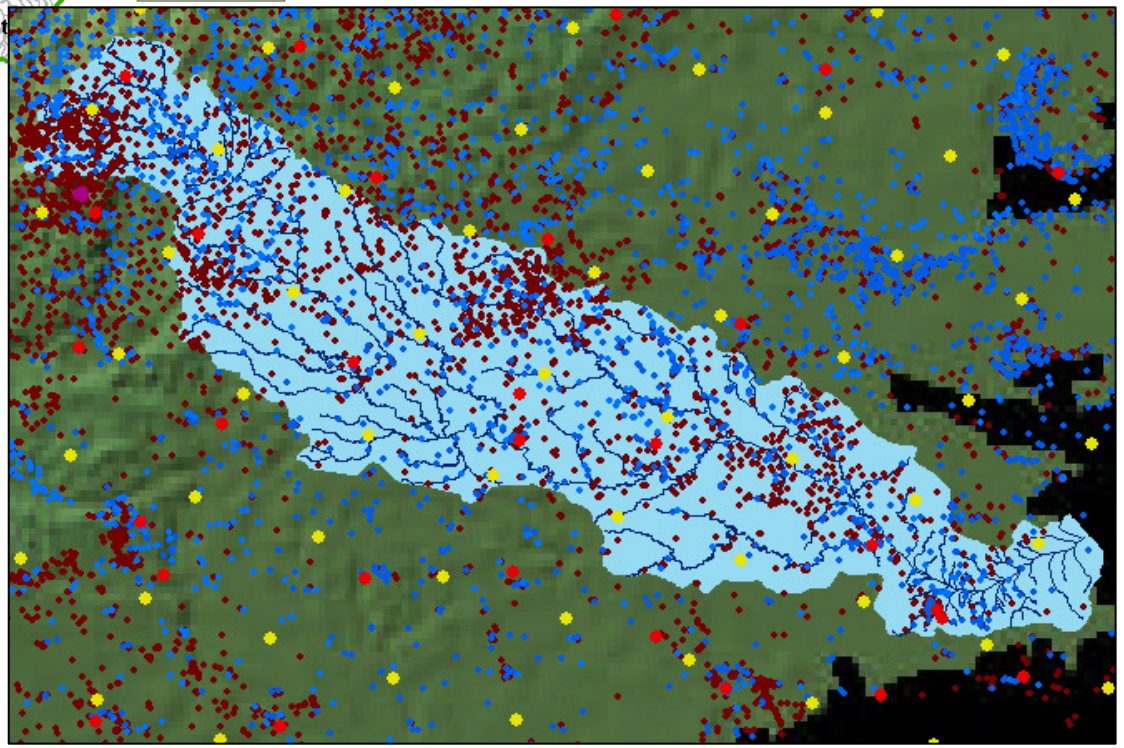
- USGS NWIS
- ASOS
- Climate Research Network
- Ameriflux

+ others…….

US Basins and Watersheds



Data Available for a Sample Watershed



- NWIS Streamflow and Water Quality
- NWIS Groundwater
- ASOS
- NARR
- Ameriflux

Project Components

1. Student investigations: 2 Case studies
2. Software and Data Library Development, Back-end integration
3. Professional Development
4. Community Development
5. Evaluation

Student Investigations

Students will use desktop or browser-based geographic information systems (GIS) to access scientific data sets provided by CUAHSI to engage in authentic scientific inquiry on local, regional, national, and international watershed dynamics.

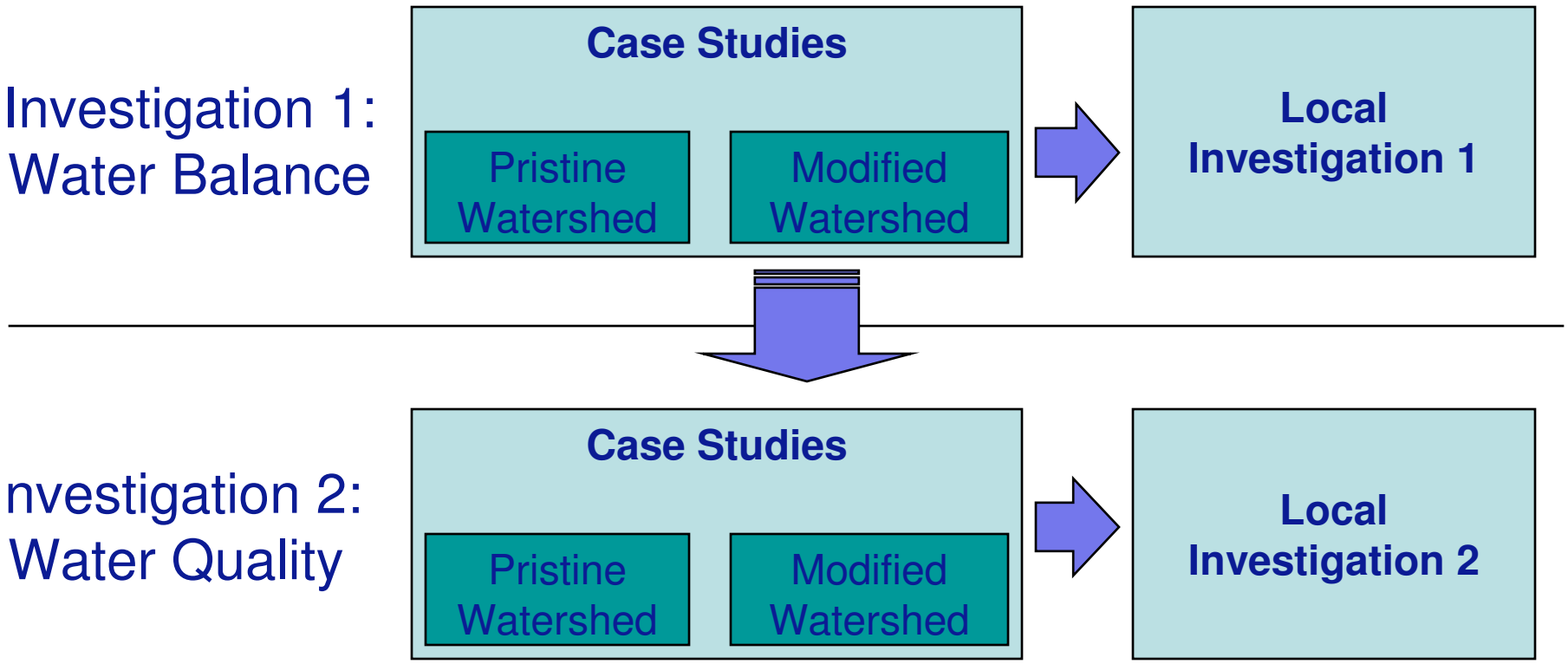
Students study the hydrology of their own watershed in order to understand:

- the flow of water through the watershed
- how the hydrology of their watershed has shaped human activities within the watershed
- how human land use is impacting the hydrology of the watershed
- what the implications of land use changes are for the plant and animal communities in the watershed

Science Content Focus

Investigation	Topics	Description
1	Water cycle, land use, flooding, infiltration, groundwater, transpiration, human environmental impacts and risks	Students analyze water balance in watershed, identify gaps, and hypothesize missing components
2	All of the above, plus: Ecosystems, destruction of habitats, erosion, eutrophication, biogeochemical cycles, groundwater transport, point-source pollution	Above activities, plus analyzing water quality issues, erosion, and runoff due urban and agricultural land use

Organization of Investigations



Who is the Intended Audience?

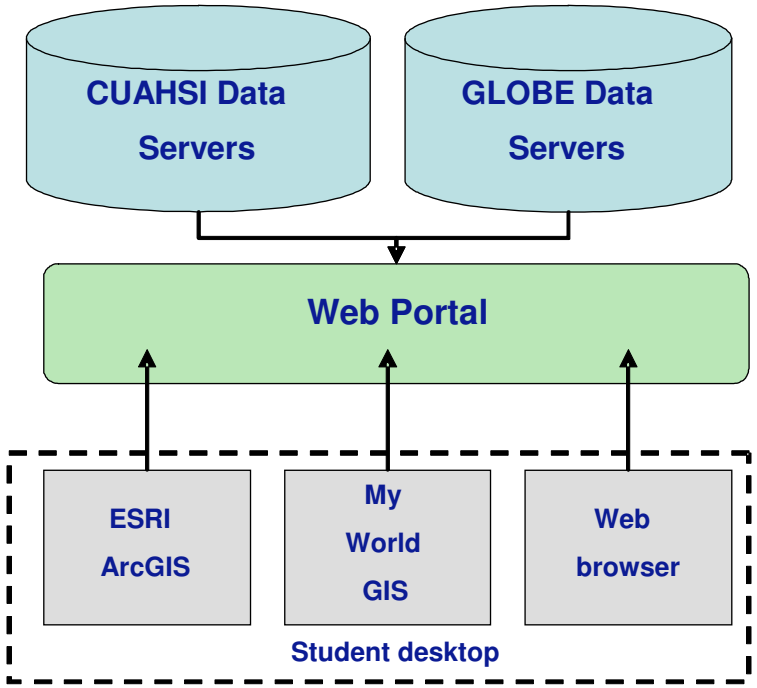
- Investigations are targeted at students in grades 6-8 and 9-12.
- We welcome the *direct* participation of upper primary and secondary school teachers in our professional development workshops.
- Teacher workshops will likely be held in Chicago, Boulder, and Austin.
- All instructional materials, data, and web-based tutorials will be available to any teachers.

International Scope

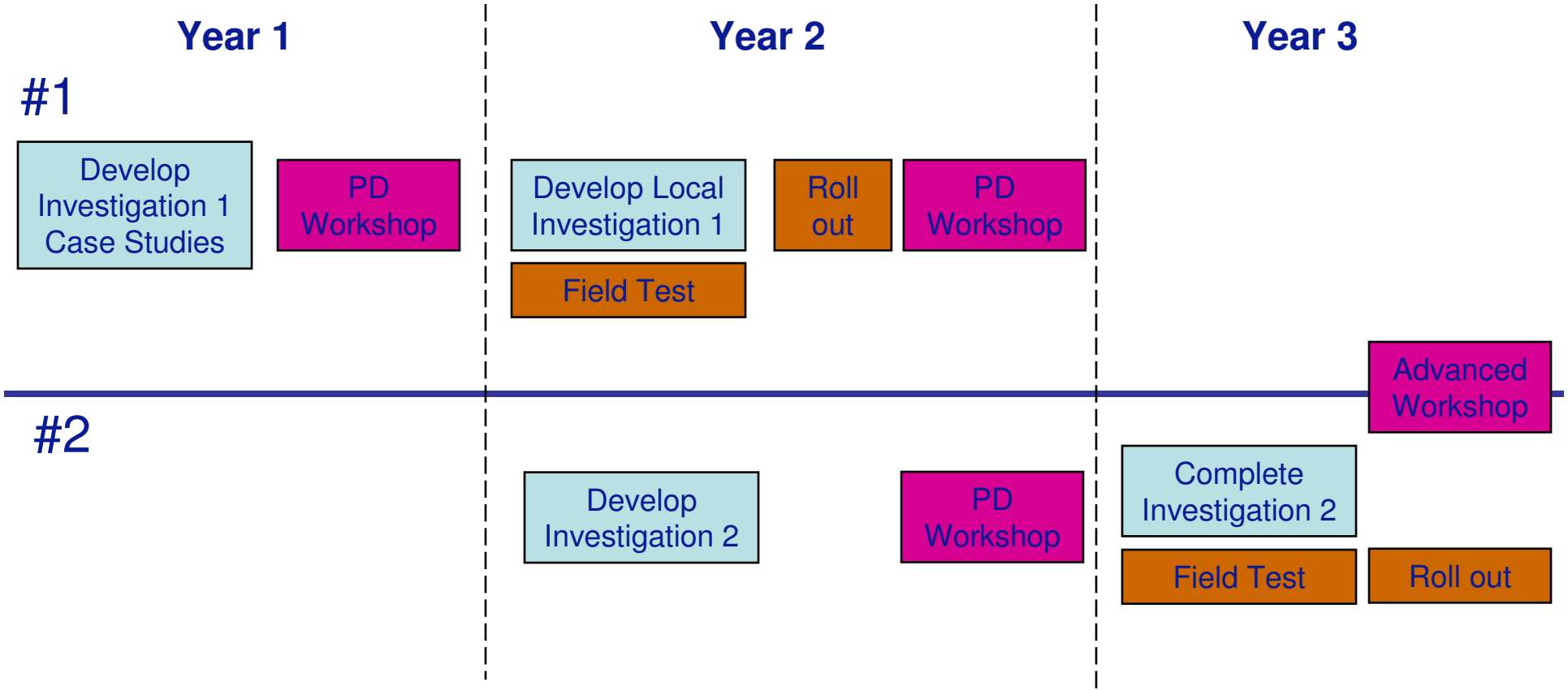
- CUAHSI data sets are focused on the continental United States
- Initial conversations with international partners to provide access to similar data
- **The Watershed Dynamics Project seeks collaboration with additional international hydrology data providers and scientists**

Technology Platform

- Teachers & students can use any of three GIS tools to suit their goals and constraints:
  - My World GIS™
  - A browser-based GIS environment built using ArcGIS® Server
  - ArcGIS®, the most widely used desktop GIS among professionals



Timeline


Year 1
Year 2
Year 3
#1
Develop Investigation 1 Case Studies
PD Workshop
Develop Local Investigation 1
Roll out
PD Workshop
Field Test
Advanced Workshop
#2
Develop Investigation 2
PD Workshop
Complete Investigation 2
Field Test
Roll out

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  Email: kjona@northwestern.edu

www.geode.northwestern.edu/GLOBE

FLEXE: From Local to EXtreme Environments


Liz Goehring


Bill Carlsen


Eric Simms


Catherine Williams

Chuck Fisher, Matt Smith, Donna Blackman, Mike Perfit and other deep-sea scientists

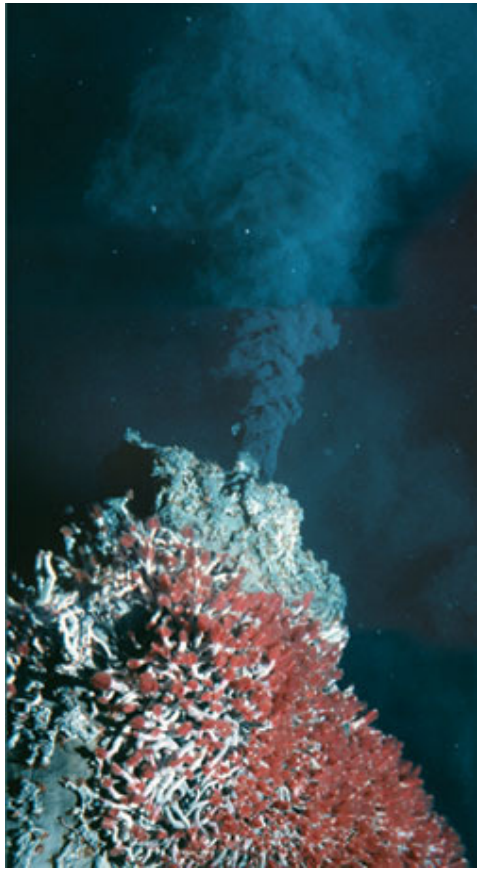
GPO FLEXE Lead: Mr. Jamie Larsen <jllarsen@globe.gov>

Ridge 2000, CSATS Penn State,

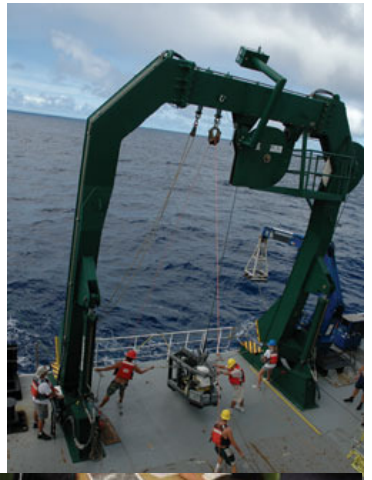
Scripps Institution of Oceanography, University of Florida

Deep-sea systems: vents and seeps

- Requires understanding of interacting processes (mantle to ecosystem)
  - Geological, hydrological
  - Chemical
  - Biological
- “Extreme environments”
  - Temperature
  - Pressure
  - pH
  - Chemicals



FLEXE goals



Scientists

- Contribute meaningfully to science education
- Use time and resources efficiently

Teachers

- See how FLEXE can help them meet relevant educational standards
- Incorporate FLEXE into classroom planning

Students (and teachers)

- Understand important Earth System Science concepts
- Develop positive attitudes to science, and interest in further science learning
- Understand the process of science; what it means to be a scientist (e.g. Nature of scientific inquiry, Science as a social endeavor

How? Progress from local to extreme

- Collect data in **local** environment
  - Student “ownership” of data
- Analyze, discuss, write up
- Peer review other students’ reports
- Receive peer reviews on own report

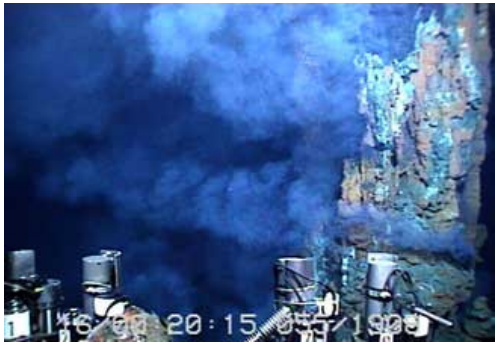
- Analyze equivalent data from **extreme**, deep-sea environment
  - Scientists pose questions to students about data
  - Scientists review student responses and give (general) feedback

FLEXE: students as researchers

- Form hypotheses, models
- Collect and analyze data
- Discuss how data do/don't support hypotheses, models
- Describe ideas, activities and arguments in writing
- Peer review others' reports
- Respond to peer reviews
- Have well-reviewed reports "published"
- "Network" with other scientists outside peer review (e.g. via FLEXE Forum)
  - Includes other students worldwide

FLEXE pilot: March-May 2007

- (With all pilot schools) Learning activity 1
  - Temperature variation around the globe
- (With a few schools) Learning activity 2
  - Temperature variation in the schoolyard
- (With all pilot schools) FLEXE Forum
  - Temperature variation in the deep sea
    - Surface to seafloor
    - Hydrothermal vents
    - Hydrothermal plumes



Learning Activity: temperature variation around the globe

- Students access existing GLOBE data on max/min temperature
- Answer questions about the data (online)
- This generates a “report”
  - Introduction, methods, results, discussion
- Students review each others’ reports
  - Some within-class
  - Others between schools

FLEXE: pilot concepts

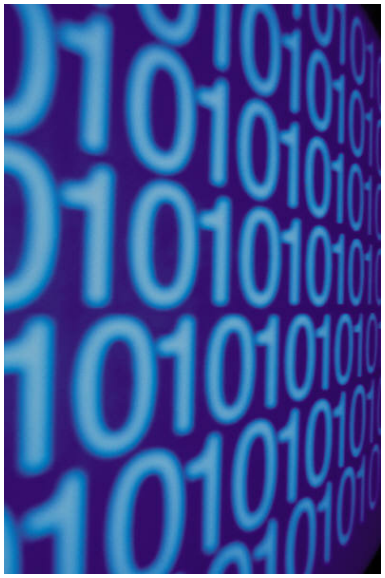
- Earth systems science concepts
  - Energy transfer processes
  - Sources of (heat) energy
- General scientific concepts
  - Variation in time and space
- Understanding of the scientific process
  - What do the data say?
  - Science as a social endeavor: role of feedback from peers

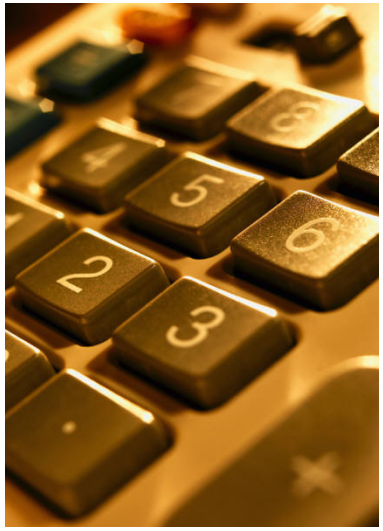
FLEXE Pilot evaluation

- Examination of student work
  - Reports
  - Peer reviews
  - (Improvement of reports in response to peer review)
  - Answers to FLEXE Forum questions
- (Randomly administered) attitude questions
  - Interest in science
- Feedback from teachers

FLEXE as part of the Next Generation GLOBE

- Data collection methods not aimed at collecting one “representative” value per school but at facilitating:
  - “Ownership” of data by students
  - Appreciation of **variation** in data - and reasons for it
  - Learning of Earth System concepts
  - Understanding of the scientific process
- Methods and data are not separate from the hypothesis, analysis and discussion
  - Methods are hypothesis driven
  - Students able to critique method and may amend it





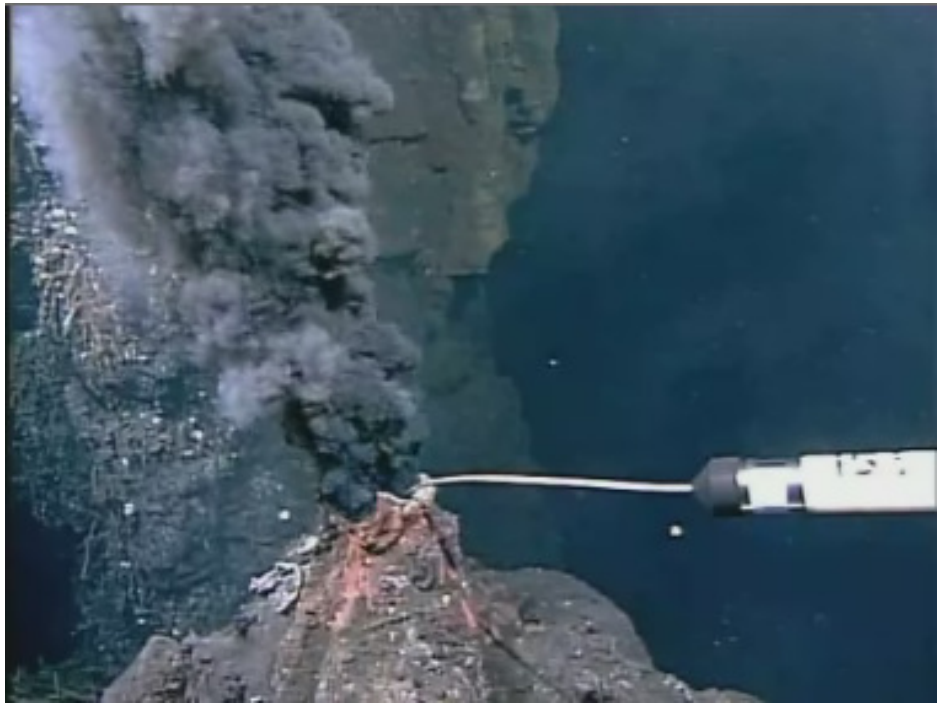
FLEXE: data access and archive needs

- Classroom activities access existing GLOBE data
  - Students analyze data and write reports
- Data collection activities lead to 10+ data sets per class, each associated with 1-3 reports
  - Method of data presentation may vary
    - Graphs, tables, summary statistics…
  - Data not meaningful outside context of report
    - May not be available except as part of report

FLEXE data presentation possibilities

- Reports are peer reviewed; well-reviewed reports are to be “published”
- Deep-sea data sets are presented for student analysis
  - Analysis tools that may be available:
    - Graphing
    - Statistics
- Scientists’ commentaries / feedback are published
  - May benefit from animations, interactive graphs etc

Contacts



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